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EMBALMING.[1]

A SATISFACTORY METHOD OF PERFORMING.

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The Public Health Service is interested in the subject of embalming in order that the interstate shipment of bodies dead from quarantinable diseases, such as plague, cholera, and smallpox, may be harmless. The Army and Navy are interested in the transportation home in good condition of bodies of officers and men who have died in the Tropics. The funeral director not infrequently is called upon to prepare a body for a long sea voyage or for transportation across the continent. On the death of heads of governments it is sometimes necessary to preserve the body for weeks or months. There should be no difficulty in meeting all the requirements in any case. The instances which I have cited call for perfect embalming—the preservation of all parts of the body and their complete sterilization. The proper fluid in right amounts must be properly injected in definite locations by one thoroughly familiar with human anatomy.

The technique of injection is a matter of the greatest importance. As we are concerned with preserving all parts of the body in an equally good condition, we must satisfy ourselves that the fluid reaches every part of the body in an amount sufficient to preserve it. A single injection into but one artery does not produce the widest possible distribution of the fluid to all the remote parts of the head and extremities. It is not denied that in temperate climates bodies are injected constantly through the brachial artery with a small amount of fluid and that the bodies are preserved for two or three days until burial. If, however, a body is to withstand the high temperature of the Tropics, its indefinite preservation will depend upon the bathing of every tissue of the body by fluid introduced into the circulation in multiple locations.

If a body be injected through but one artery, say the right brachial toward the heart, what assurance is there that the right arm below the site of injection will receive any of the fluid, or that the head will

[1] Read before the Georgia State Funeral Directors' Association, Savannah, Ga., June 16, 1915.

get a sufficient amount to preserve it, or that the opposite arm or the legs will get their proper proportion of fluid? The chances are that the amount will vary in different parts and some part perhaps will get none at all.

When the fluid is introduced into the circulation at but one place, the operator takes great chances against a uniform distribution of fluid throughout all parts of the body; consequently the parts which receive the least fluid will be the first to show signs of decay.

In order to get a uniform distribution of fluid, it is usually necessary to make six injections, i. e., into each brachial artery toward the fingers, into each femoral artery toward the toes, into one common carotid artery toward the head, and into the same carotid toward the heart. In each instance, when injecting the brachial artery, or the femoral or the carotid artery upward, fluid is immediately seen returning through the veins. In this way the operator has the assurance that the fluid actually bathes all the tissues of the extremities or head and he can rest assured that the parts will be preserved.

To so embalm a body that it will withstand a tropical sun, or a long sea voyage, or that it may be kept in state for weeks or months, or that it may be harmless on account of communicable disease, the embalmer should inject the arterial system in the six locations indicated with a total amount of fluid equal to 15 per cent of the body weight.

The maximum amount of fluid which in practical embalming it would be desirable to inject into the arteries would depend upon circumstances. It is an easy matter to overinject the head or extremities so that the face and hands are puffy and unnatural; if the eyes, lips, or one side of the face become overdistended, the injection should cease; sometimes fluid can not be forced into an artery, due perhaps to clots; with practice one learns to disregard actual amounts and to stop the injection of an extremity when it is apparent that the fluid has circulated well from the arteries, through the capillaries and back into the veins. In many instances the effects of overinjection are not objectionable, particularly if the casket is not to be opened or if a long time is to be consumed in transportation before the body is viewed at its destination.

Sites of Injection and Amounts to be Employed.

Inject into the arterial system an amount of fluid equal to 15 per cent of the body weight, figuring 450 cc. of fluid as 1 pound.

Inject each femoral artery toward toes with 2 per cent body weight.

Inject each brachial artery toward fingers with 1 per cent body weight.

Inject one common carotid artery toward head with 2 per cent body weight.

Inject same common carotid artery toward heart with 7 per cent body weight.

Total amount of fluid, including both femorals and both brachials, 15 per cent body weight.

If fluid can not be forced into an artery, due perhaps to clots, the extremity should be wrapped in cotton soaked in the fluid and then bandaged; the cotton should be resaturated from time to time. It is not necessary to withdraw blood from the veins, although there is no objection to doing so. It is not necessary to inject fluid into the thoracic and abdominal cavities. Autopsied bodies are to be treated in the same way as nonautopsied ones, but a liberal amount of cotton and embalming fluid should be supplied to the cavities of the abdomen, chest, and skull. Plug the anus, mouth, and nostrils with cotton soaked in the embalming fluid. Wash the entire body, including the face, ears, and hair, with the fluid. If desirable to keep the body for a long time, drying can be prevented by rubbing vaseline liberally over the entire body followed by bandaging the same.

Thirty cadavers were injected in accordance with these rules and after injection they were kept in a room at 98° F. for periods varying from one month to seven weeks; on the dissecting table these bodies excelled in the matter of preservation, firmness, and natural color of the tissues.

The injection apparatus consists of a 3-gallon bottle, through the rubber stopper of which pass two glass tubes; one tube extends to the bottom of the bottle and affords an outlet to the fluid, which is carried by a rubber tube to the glass injection canula; the other tube is connected by rubber tubing to a pump. A bicycle foot pump is very effective.

The exact composition of an embalming fluid is, I think, of far less importance than the method of injecting it. Probably any one of the many fluids found on the market will preserve a body if administered by skillful hands.

The formula of an embalming fluid which was devised at the Hygienic Laboratory of the Public Health Service, which has been found stable in composition after standing two years and eight months, and which has proven effective in preserving human subjects exposed for two months to a temperature of 98° F. after being embalmed is as follows:

Liquor formaldehyde [1] (U. S. P. solution of formaldehyde), 13.5 cc.
Sodium borate (borax, $Na_2B_4O_7$), 5 grams.
Water sufficient to make 100 cc.

The above formula is based on the idea that formaldehyde is the best preservative and disinfectant which can be used in an embalming fluid. It constituted the essential ingredient in nearly all commercial fluids analyzed at the Hygienic Laboratory.[2] One very serious

[1] Should the strength of the solution of formaldehyde used be below 37 per cent, its amount must be proportionately increased, using, for example, 15 cc. of a solution of only 33⅓ per cent strength.

[2] Passed Asst. Surg. Norman Roberts, U. S. P. H. S.: Chemical examination of 24 commercial embalming fluids, Proceedings of the twenty-ninth annual convention, National Funeral Directors' Association, September, 1910, p. 97.

objection to formaldehyde is that it bleaches muscular tissue to an ashy gray. In the course of our investigation, this objection was found to be overcome by adding an alkali to the formaldehyde solution, thus changing its reaction from acid to alkaline. In the selection of the proper alkali it was found, however, that the common alkalis caused a deterioration of the formaldehyde after several weeks' standing. On account of the instability of formaldehyde in the presence of sodium hydrate, potassium hydrate, ammonium hydrate, sodium sulphite, and sodium carbonate they all had to be abandoned, whereas borax was found to furnish the desired alkalinity without causing more than the very slightest deterioration of the formaldehyde after having been made up almost three years. Borax has the additional advantage of being in itself a preservative.

Table showing the instability of formaldehyde after the addition of various alkalies and showing its stability in the presence of borax.

Aqueous solutions of formaldehyde rendered alkaline by the addition of—	Percentage of formaldehyde in the solutions after having stood—			
		6 weeks.		
Borax, sodium borate ($Na_2B_4O_7$)	Made up with approximately 5.5 per cent formaldehyde.	5.47		
Sodium carbonate (Na_2CO_3)	....do....	5.10		
Sodium sulphite (Na_2SO_3)	....do....	4.25		
Ammonium hydrate (NH_4OH)	....do....	2.15		
Sodium hydrate (NaOH)	....do....	0.90		
	1 day.	4 weeks.	10 weeks.	2 years 8 months.
Sodium carbonate, 1 per cent	5.11	4.87	4.72	4.59
Sodium carbonate, 2 per cent	5.10	4.78	4.58	4.22
Sodium carbonate, 3 per cent	5.09	4.76	4.50	3.85
Sodium carbonate, 5 per cent	5.09	4.69	4.38	3.57
Sodium carbonate, 10 per cent	5.09	4.61	4.24	3.12
Borax, 3 per cent	5.14	5.05	5.02	5.00
Borax, 5 per cent	5.11	5.07	5.00	.98

The determinations of the amounts of formaldehyde were made by Elias Elvove, technical assistant, Hygienic Laboratory, United States Public Health Service.

PARALYSIS DURING ANTIRABIC TREATMENT.

REPORT OF TWO CASES OF PARALYSIS, WITH ONE DEATH, OCCURRING DURING THE COURSE OF ANTIRABIC TREATMENT.

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In the Public Health Reports [1] of October 24, 1913, the author reported two cases of paralysis occurring during the course of antirabic treatment.

[1] Hasseltine, H. E. Public Health Reports, 1913, vol. 28, pp. 2220-2225.